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ALBUQUERQUE, NEW MEXICO
METROPOLITAN AREA
AIR POLLUTANT EMISSION INVENTORY

U. S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
Public Health Service
Environmental Health Service

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AIR POLLUTANT EMISSION INVENTORY

Prepared by
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U. S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
PUBLIC HEALTH SERVICE
Environmental Health Service
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PREFACE

This report, which presents the emission inventory for the Albuquerque Metropolitan Area, is another in a series of surveys outlining the sources and emissions of air pollutants for major metropolitan areas in the country. These surveys, conducted by the National Inventory of Air Pollutant Emissions and Control Branch of the National Air Pollution Control Administration, provide estimates of the present levels of air pollutant emissions and status of their control. The pollutants, which include sulfur oxides, particulates, carbon monoxide, hydrocarbons and nitrogen oxides, are delineated with respect to source type, season of the year and geographical distribution within the area. The general procedure for the surveys is based upon the rapid survey technique for estimating air pollutant emissions.¹ These reports are intended to serve as aids in the proposing of boundaries of Air Quality Control Regions, as directed by the Air Quality Act of 1967.

ACKNOWLEDGMENTS

Sincere gratitude is extended by the National Air Pollution Control Administration to the many individuals and companies who contributed to this air pollution emission inventory.

Special thanks are extended to Dick Burgard, Supervisor of the New Mexico Air Pollution Control Program and Lane Kirkpatrick, Air Management Engineer of the Albuquerque Environmental Health Department, who contributed invaluable assistance in the gathering of data for this report.

TABLE OF CONTENTS

	Page
Introduction.....	1
Summary of Results.....	3
Description of Study Area.....	6
Grid Coordinate System.....	13
Emissions by Category.....	16
Stationary Fuel Combustion.....	16
Steam-Electric.....	16
Industrial and Commercial-Institutional.....	16
Residential.....	20
Transportation.....	20
Road Vehicles.....	20
Aircraft.....	22
Railroads.....	22
Solid Waste Disposal.....	25
Industrial Process Losses.....	28
Evaporative Losses.....	28
Emissions by Jurisdiction.....	32
Emissions by Grid.....	37
References.....	47

LIST OF TABLES

Table		Page
1	Summary of Air Pollutant Emission in English Units.....	4
1A	Summary of Air Pollutant Emission in Metric Units.....	5
2	Area and Population Characteristics for Study Area.....	9
3	Number of Industrial Establishments in Study Area.....	12
4	Annual Fuel Consumption for Study Area.....	17
5	Chemical Analysis of Fuel Burned in Study Area.....	18
6	Air Pollutant Emissions from Fuel Combustion in Stationary Sources.....	19
7	Vehicle Miles of Travel for Road Vehicles.....	21
8	Air Traffic Activity at Albuquerque International Airport...	23
9	Air Pollutant Emissions from Transportation Sources.....	24
10	Solid Waste Disposal Balance.....	26
11	Air Pollutant Emissions from Solid Waste Disposal.....	27
12	Air Pollutant Emissions from Industrial Processes.....	29
13	Hydrocarbon Emissions from Evaporative Losses.....	30
14	Summary of Air Pollutant Emissions in Bernalillo County.....	33
15	Summary of Air Pollutant Emissions in Sandoval County.....	34
16	Summary of Air Pollutant Emissions in Socorro County.....	35
17	Summary of Air Pollutant Emissions in Valencia County.....	36
18	Summary of Air Pollutant Emissions from Point Sources.....	39
19	Summary of Air Pollutant Emissions from All Sources.....	40

LIST OF FIGURES

Figure		Page
1	Map of Albuquerque Study Area and Surrounding States.....	7
2	Detailed Map of Albuquerque Study Area.....	8
3	Population Density Map of Albuquerque.....	10
4	Grid Coordinate System for Albuquerque.....	14
5	Point Source Locations.....	38
6	Sulfur Oxides Emissions Density Map.....	42
7	Particulate Emission Density Map.....	43
8	Carbon Monoxide Emission Density Map.....	44
9	Hydrocarbon Emission Density Map.....	45
10	Nitrogen Oxide Emission Density Map.....	46

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INTRODUCTION

This report is a summary of the Albuquerque area air pollutant emission inventory conducted in March 1970. Since all inventories are based upon a calendar year, the data and emission estimates presented are representative of 1969 and should be considered as indicating the conditions as existed during that year.

The Study Area, which was chosen on the basis of the distribution of population and air pollution sources, consists of one complete county, Bernalillo, and portions of three others--Sandoval, Socorro, and Valencia. This area covers approximately 5,700 square miles and had a 1969 population of 365,000.

A grid coordinate system was used to show the geographical distribution of emissions within counties. The Study Area was subdivided into 52 grid zones ranging in size from 25 square kilometers in the heavily populated and industrialized areas to 1,600 square kilometers in the rural areas.

All sources of emissions were classified into five categories--transportation, stationary fuel combustion, solid-waste disposal, industrial processes and evaporative losses. Each of these source categories was divided into two subgroups--point sources and area sources. Facilities, which emit large quantities of air pollutants, were considered individually as point sources, while the many remaining contributors such as motor vehicles, residential and commercial fuel users, small industries and on-site refuse burning equipment were considered collectively as area sources. For this report, 19 individual sources, which had emissions greater than 0.25 tons per average annual day for any pollutant, were classified as point sources.

Emissions were estimated by using various indicators such as fuel consumption, refuse burning rates, vehicle-miles, production data, control efficiencies and emission factors relating these indicators to emission rates.² These factors represent average emission rates for

a particular source category. Since individual sources have inherent differences that cannot always be taken into consideration, discrepancies between the actual and estimated emissions are more likely in individual sources than in the total emissions for a source category.

As in all emission surveys, the data presented are estimates and should not be interpreted as absolute values. The estimates are, in some cases, partial totals due to the lack of emission factors and production or consumption data. Despite these limitations, the estimates are of sufficient accuracy and validity to define the extent and distribution of air pollutant emissions in the Study Area.

SUMMARY

An estimated 0.2 million tons of five major pollutants are emitted annually in the Study Area. The breakdown of these emissions by type of pollutant and source category are summarized in Table 1. The following is a presentation of the relative contribution of different source categories.

Sulfur Oxides	1968 Total - 1,600 Tons	
	Transportation Sources	80%
	Stationary Fuel	15%
	Other	5%
Particulates	1968 Total - 9,300 Tons	
	Industrial Processes	54%
	Transportation Sources	33%
	Solid Waste Disposal	10%
	Other	3%
Carbon Monoxide	1968 Total - 158,000 Tons	
	Motor Vehicles	89%
	Industrial Processes	4%
	Solid Waste Disposal	3%
	Aircraft & Railroads	3%
	Other	1%
Hydrocarbons	1968 Total - 23,800 Tons	
	Motor Vehicles	50%
	Evaporative Losses	33%
	Aircraft & Railroads	10%
	Solid Waste Disposal	6%
	Other	1%
Nitrogen Oxides	1968 Total - 16,900 Tons	
	Motor Vehicles	53%
	Steam-Electric	21%
	Aircraft & Railroads	16%
	Other	10%

TABLE 1 SUMMARY OF AIR POLLUTANT EMISSIONS IN THE ALBUQUERQUE
STUDY AREA, 1969 (Tons/Year)

Source Category	Sulfur Oxides	Partic- ulates	Carbon Monoxide	Hydro- carbons	Nitrogen Oxides
Transportation					
Motor Vehicles	830	1,580	141,700	11,750	9,000
Other	420	1,440	4,510	2,400	2,710
Subtotal	1,250	3,020	146,210	14,150	11,710
Stationary Fuel Combustion					
Industry	0	0	0	0	0
Steam-Electric	170	140	0	0	3,550
Residential	60	100	20	0	560
Commercial- Institutional	0	80	0	0	500
Subtotal	230	320	20	0	4,610
Solid Waste Disposal					
Incineration	50	220	990	20	70
Open Burning	40	700	3,740	1,320	480
Subtotal	90	920	4,730	1,340	550
Industrial Processes	0	5,030	7,010	590	50
Evaporative Losses	--	--	--	7,750	--
TOTAL ALL SOURCES	1,570	9,290	157,970	23,830	16,920

TABLE 1A SUMMARY OF AIR POLLUTANT EMISSIONS IN THE ALBUQUERQUE
STUDY AREA, 1969 (Metric Tons/Year)

Source Category	Sulfur Oxides	Partic- ulates	Carbon Monoxide	Hydro- carbons	Nitrogen Oxides
Transportation					
Motor Vehicles	750	1,430	128,600	10,660	8,160
Others	380	1,310	4,090	2,180	2,460
Subtotal	1,130	2,740	132,690	12,840	10,620
Stationary Fuel Combustion					
Industry	0	0	0	0	0
Steam-Electric	150	130	0	0	3,220
Residential	50	90	20	0	510
Commercial- Institutional	0	70	0	0	450
Subtotal	200	290	20	0	4,180
Solid Waste Disposal					
Incineration	50	200	900	20	60
Open Burning	40	640	3,390	1,200	440
Subtotal	90	840	4,290	1,220	500
Industrial Processes	0	4,560	6,360	540	50
Evaporative Losses	--	--	--	7,030	--
TOTAL ALL SOURCES	1,420	8,430	143,360	21,630	15,350

* Metric ton = 1000 kilograms

DESCRIPTION OF STUDY AREA

The Study Area for the Albuquerque, New Mexico Metropolitan Area Air Pollutant Emission Inventory covers the central portion of the State of New Mexico. As can be seen in Figure 1, the Study Area is a considerable distance from other metropolitan areas.

The four counties included in the Study Area (Figure 2) are: Bernalillo County, Sandoval County, Socorro County and Valencia County. Bernalillo County is a designated Standard Metropolitan Statistical Area (SMSA). Portions of Sandoval, Socorro and Valencia Counties, were included to insure that all areas which may have a high rate of growth in future years are in the Study Area.

The approximate 1969 population for the Study Area was 365,000. Although the area is 5,700 square miles, the majority of the people live in an urbanized area of only 100 square miles (1960). Table 2, which gives populations by county, and Figure 3, which is a population density map, show that most of this urbanized area is in Bernalillo County. The population in the four county area has increased at a quicker pace than the nation as a whole. Between 1960 and 1969, the nation's population increase about 12 percent, and the Albuquerque Study Area increased about 20 percent.

TOPOGRAPHY

The Rio Grande River flows through the central portion of the Study Area. East of the Study Area are the Manzo Mountains which rise 2,000 to 3,000 feet above Albuquerque. West of Albuquerque are large areas of arid land which have been established as Indian Reservations.

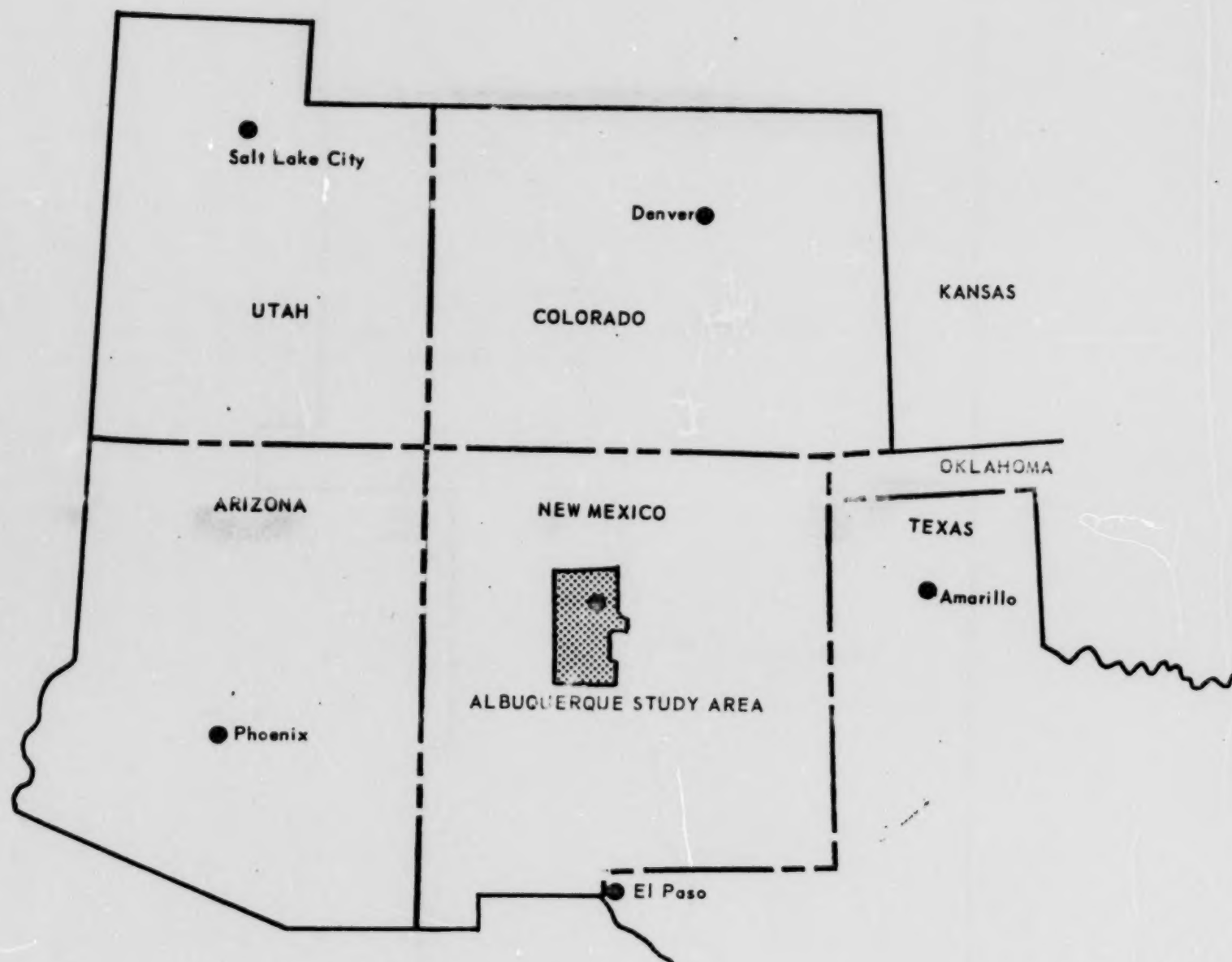


Figure 1. Map of Albuquerque study area and surrounding states.

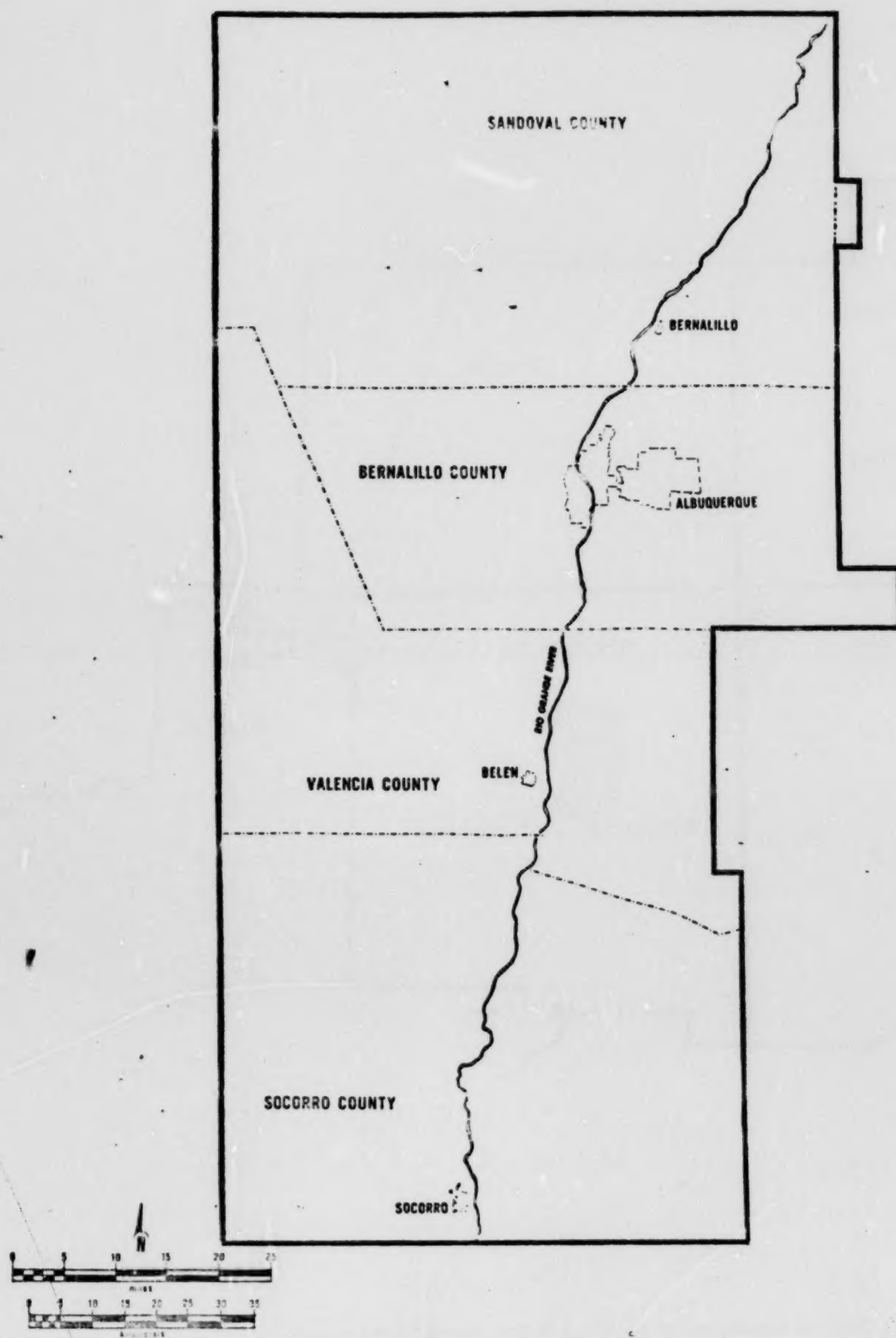


Figure 2. Detailed map of the Albuquerque study area.

TABLE 2 AREA AND POPULATION CHARACTERISTICS FOR THE ALBUQUERQUE
STUDY AREA

County	Land Area (Sq. Mi.)	Land Area in Study Area	Total Pop. 1960	Total Pop. 1969	1969 Pop. in Study Area	Density of Study Area
Bernalillo County	1,169	1,169	262,200	325,000	325,000	278
Sandoval County	3,714	1,800	14,200	18,600	18,000	10
Socorro County	6,603	1,300	10,170	10,400	10,000	8
Valencia County	5,656	1,400	39,100	38,300	12,000	9
STUDY AREA	17,142	5,669	325,670	392,300	365,000	64

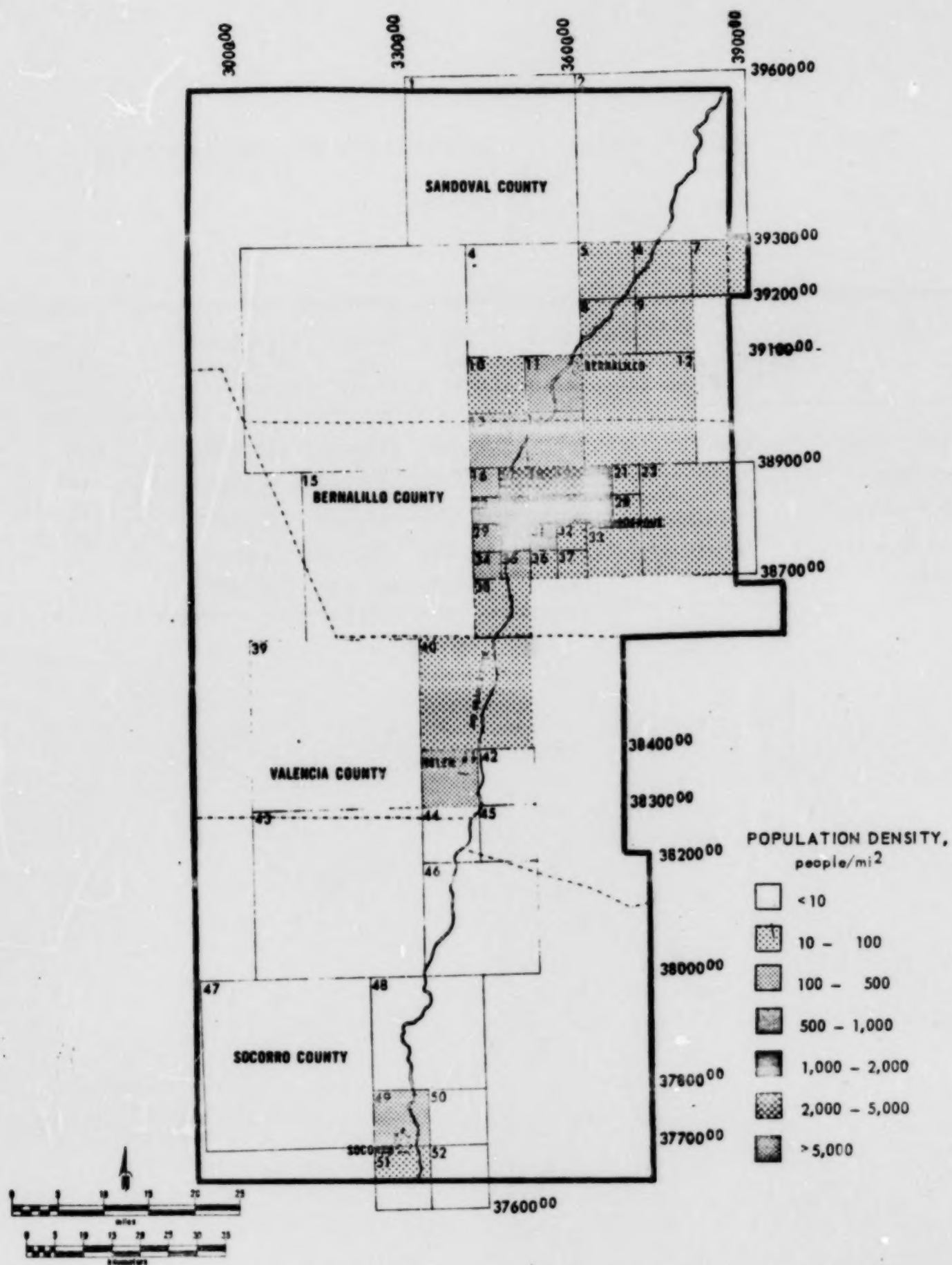


Figure 3. Population density map for Albuquerque study area.

CLIMATOLOGY

The Albuquerque area has an arid continental climate. The average monthly precipitation in Albuquerque varies from less than one-half inch during the winter months, to over an inch during the months of July and August. Because the average yearly rainfall amounts to about eight inches per year, there is generally insufficient natural moisture to maintain the growth of any but the most hardy vegetation.

Temperatures in the Albuquerque area show a relatively high daily variation. Daytime temperatures during the winter average near 50° with only a few days in which the temperature does not raise above the freezing mark. In the summer, daytime temperatures average less than 90°, but the nights are generally cool.

Wind movement throughout the year averages around nine miles per hour, but during the late winter and spring months the average is somewhat higher and occasionally causes dust storms. These dust storms are the most discomforting part of Albuquerque's climate.

INDUSTRIAL FACTORS

The industry in the Study Area is concerned with cattle, mining and lumber. Except for a concrete manufacturer and a gypsum manufacturer, there is very little heavy or light industry in the Study Area. The number of industrial establishments located in the four counties is shown in Table 3.

TABLE 3 NUMBER OF INDUSTRIAL ESTABLISHMENTS IN THE ALBUQUERQUE
STUDY AREA, 1960

Industry	Bernalillo County	Sandoval County	Socorro County	Valencia County
Food and Tobacco	20	0	0	1
Textiles	1	0	0	0
Paper and Printing	7	0	0	0
Chemicals	2	0	0	0
Lumber and Wood	14	2	0	0
Sand and Gravel	9	0	0	0
Primary and Intermediate Metals	4	0	0	0
Electrical Machinery	10	0	0	1
Transportation and Ordinance	4	0	0	0
Instruments and Miscellaneous	3	0	0	0

GRID COORDINATE SYSTEM

A grid coordinate system, based on the Universal Transverse Mercator Projection (UTM), was used in the Albuquerque Study Area to indicate the geographical distribution of emissions. A map showing the grid coordinate system is presented in Figure 4.

An evaluation of the available coordinate systems was completed before choosing the UTM system to present emissions in this series of emission inventories. The systems evaluated were the State Plane system, the Longitude-Latitude system and the UTM system. Although each of the systems had valuable qualities, the use of the UTM coordinate system was felt to completely meet the requirements of these emission inventories.

Two primary requirements of the grid coordinate system were used to evaluate each system. One of the requirements was that the grid coordinate system had to have square grid zones, since the data were to be used in meteorological dispersion models. The grid zones, which the UTM system and most of the State Plane systems project, are always square, but the longitude-latitude system projects grid zones that become skewed as the zones become further from the equator. The other quality the grid coordinate system had to possess was consistency. Each emission inventory should be conducted on a grid coordinate system which uses the same reference point throughout the Study Area. Since some air pollutant inventories would include areas in two or more states, the State Plane systems could not be used. However, since the UTM system, as well as the longitude-latitude system, is not referenced to points in individual states, it is not influenced by jurisdiction boundaries. The UTM system was chosen since it was the only coordinate system which could project square grid zones over any Study Area using a common reference point.

The Universal Transverse Mercator Projection is based upon the metric system. Each north-south and east-west grid lines, as illustrated

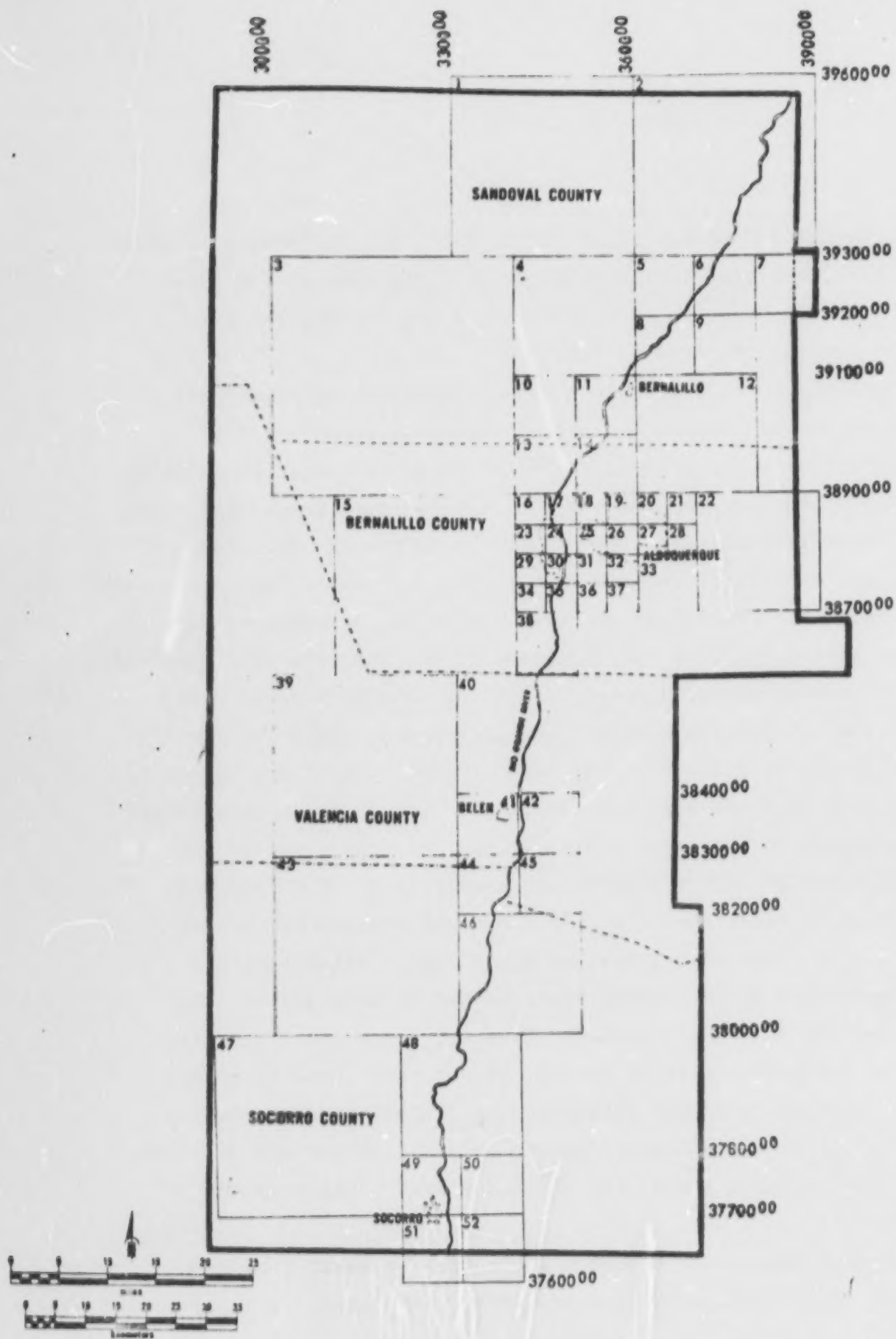


Figure 4. Grid coordinate system for the Albuquerque study area.

in Figure 4, is identified by a coordinate number expressed in meters. Each point source and grid, using the geographical center of the grid, is identified by a horizontal and vertical coordinate to the nearest 100 meters.

Grid zones of different sizes are used in the grid coordinate system to allow a satisfactory definition of the geographical gradation of emissions and to limit the number of grid zones. Since majority of the emissions is usually concentrated in the populated and industrialized portions of a Study Area, smaller grids are placed over these areas to allow the grid coordinate system to reflect the changes of emissions over short distances. Grid zones smaller than the 25 kilometer grid zones used in this report are not usually warranted because of the inherent inaccuracies in the data. Larger grid zones are used in the rural portions, because a smaller portion of the total emissions usually occurs in lightly populated areas.

STATIONARY FUEL COMBUSTION

The stationary fuel combustion source category is concerned with four primary sources: industrial facilities, steam-electric plants, residential housing, and commercial and institutional establishments. Four fuels are usually burned in these sources: coal, residual fuel oil, distillate fuel oil and natural gas. Other fuels such as woodwaste and LPG are also included if there is a sufficient amount being burned.

Steam-Electric

Fuel consumption data were acquired from the various power companies in the Study Area by the State Air Pollution Section through personal communications. Data received on four power plants included the monthly fuel consumption for 1969, and sulfur content of the fuel oil where burned.

Steam-electric power plants in the Study Area burn two fuels: residual fuel oil and natural gas. Natural gas is used by all the power plants as the primary fuel and the residual fuel oil is only used infrequently in the winter months.

The nitrogen oxide emissions is the only major pollutant caused by steam-electric power plants. Power plants emit approximately 3,500 tons of nitrogen oxides per year which accounts for 76 percent of the nitrogen oxides emitted by stationary fuel combustion.

Industry and Commercial-Institutional

Fuel consumption for both categories was obtained from cooperating natural gas companies in the Study Area. Natural gas is the only major fuel burned in either type of source. Although natural gas is being burned in all four counties by commercial-institutional sources, only Bernalillo County has natural gas being burned by industry.

TABLE 4 SUMMARY OF FUEL COMBUSTION IN ALBUQUERQUE STUDY AREA, 1969

Fuel Type	Residential	Commercial- Institutional	Industrial	Steam- Electric
<u>Natural Gas (10^6 cu ft/yr)</u>				
Bernalillo County	8,900	8,000	4,000	17,900
Sandoval County	200	100	0	0
Socorro County	200	200	0	0
Valencia County	200	400	0	0
<u>Distillate Fuel Oil (1000 gal/yr)</u>				
Bernalillo County	1,400	0	0	0
Sandoval County	100	0	0	0
Socorro County	100	0	0	0
Valencia County	300	0	0	0
<u>Residual Fuel Oil (1000 gal/yr)</u>				
Bernalillo County	0	0	0	1,000
Sandoval County	0	0	0	0
Socorro County	0	0	0	0
Valencia County	0	0	0	0
<u>Coal (Tons/yr)</u>				
Bernalillo County	400	0	0	0
Sandoval County	200	0	0	0
Socorro County	0	0	0	0
Valencia County	100	0	0	0

TABLE 5 CHEMICAL ANALYSIS OF FUELS IN THE ALBUQUERQUE STUDY AREA

	<u>Percent Sulfur</u>	<u>Percent Ash</u>
Coal	0.9	7.8
Residual Fuel Oil	2.1	
Distillate Fuel Oil	0.32	
Natural Gas	0.0008	

TABLE 6 AIR POLLUTANT EMISSIONS FROM STATIONARY FUEL COMBUSTION
IN THE ALBUQUERQUE STUDY AREA, 1969 (Tons/Year)

Source Category	Sulfur Oxides	Partic- ulates	Carbon Monoxide	Hydro- carbons	Nitrogen Oxides
Natural Gas					
Industrial	0	0	0	0	0
Steam-Electric	0	130	0	0	3,500
Residential	0	90	0	0	550
Commercial- Institutional	0	80	0	0	510
Subtotals	0	300	0	0	4,560
Fuel Oil					
Industrial	0	0	0	0	0
Steam-Electric	170	0	0	0	50
Residential	50	10	0	0	10
Commercial- Institutional	0	0	0	0	0
Subtotal	220	10	0	0	60
Coal					
Industrial	0	0	0	0	0
Steam-Electric	0	0	0	0	0
Residential	10	10	20	0	0
Commercial- Institutional	0	0	0	0	0
Subtotals	10	10	20	0	0
STUDY AREA	230	320	20	0	4,620

Residential

Fuel consumption in residential sources was obtained from cooperating natural gas companies and an analytical procedure presented in a NAPCA publication. This procedure was used to estimate the quantity of distillate fuel oil and coal burned in the Study Area.

TRANSPORTATION

The transportation source category is concerned with mobile air pollutant sources. Sources included in this category include: road vehicles, aircraft and railroads.

Road Vehicles

In order to obtain the most accurate data on the motor vehicle activity in the Study Area, the New Mexico State Department of Highways was asked to supply the total vehicle-miles for each county.

The proportioning of the county vehicle mile data into grids was completed using two methods. The first method utilized a traffic flow map of Albuquerque obtained from the State Highway Department. The grid coordinate system was drawn over the maps and the vehicle miles on the major streets and roads were measured for their respective grids. A second method used the population of each grid as the basis of proportioning the vehicle miles. Only those vehicle miles left undistributed by the first method were proportioned by population.

Accurate diesel powered motor vehicle activity was obtained from state diesel fuel consumption figures.⁷ These fuel numbers were translated into vehicle miles by assuming all diesel powered vehicles averaged 5.1 miles per gallon.¹ The state totals were proportioned into the counties by using the state to county ratios obtained from the vehicle-mile data. Diesel powered vehicle miles were proportioned only into those grids which had major highways and roads within their borders.

TABLE 7 VEHICLE MILES TRAVELED BY ROAD VEHICLES IN THE ALBUQUERQUE
STUDY AREA, 1969 (1000 v.m./Day)

County	Gasoline Powered	Diesel Powered	Total
Bernalillo County	3,656	179	3,835
Sandoval County	309	15	324
Socorro County	376	18	394
Valencia County	295	14	309
STUDY AREA	4,636	226	4,862

Emission controls were taken into consideration when automobile emissions were calculated. The efficiency of control and the age and variety of automobiles were based upon national averages.

Vehicle activity in the Study Area was greatest in Bernalillo County. The number of vehicle miles traveled can be seen in Table 7. Road vehicles, a major contributor of three of the pollutants surveyed, were the dominant source within the transportation source category. They contributed 96 percent of the carbon monoxide, 89 percent of the hydrocarbons and 77 percent of the nitrogen oxides. Sulfur oxides and particulates were emitted but to a lesser degree when compared to the other transportation sources. When compared to all sources in the Study Area, road vehicles also ranked number one in amount of carbon monoxide, hydrocarbon and nitrogen oxide emissions (Table 1).

Aircraft

Data were obtained for the Albuquerque International Airport. The data received included number of flights per day and number and type of engines per flight. This information was collected by personal communication with the air controller at the airport. Information was not secured on the small private airports in the Study Area, because accurate information was not available.

As can be seen in Tables 1 and 9, aircraft emissions account for a small portion of the total emissions in the transportation source category and in the Study Area. Within the transportation source category, aircraft contribute 10 percent of the particulates, 3 percent of the carbon monoxide, 4 percent of the hydrocarbons and 3 percent of the nitrogen oxides.

Railroads

Information on the fuel consumption of railroads for the State of New Mexico was obtained from an American Petroleum Institute publication.⁸ These figures were proportioned into the Study Area and then into the individual counties on the basis of population. The county totals were proportioned

TABLE 8 AIR TRAFFIC ACTIVITY AT THE ALBUQUERQUE INTERNATIONAL
AIRPORT, 1969 (Flights/Year)

	<u>1 Engine</u>	<u>2 Engines</u>	<u>3 Engines</u>	<u>4 Engines</u>
Conventional Jets	8,100	0	0	9,500
Fan Jets	0	1,800	5,600	10,900
Turboprop	0	6,100	0	3,700
Piston	46,800	13,300	0	0

TABLE 9 AIR POLLUTANT EMISSIONS FROM TRANSPORTATION SOURCES IN
THE ALBUQUERQUE STUDY AREA, 1968 (Tons/Year)

Source Category	Sulfur Oxides	Partic- ulates	Carbon Monoxide	Hydro- carbons	Nitrogen Oxides
Motor Vehicles	.				
Gasoline Powered	510	680	141,210	10,640	7,190
Diesel Powered	330	900	490	1,110	1,810
Evaporative Losses	--	--	--	7,100	--
Subtotal	840	1,580	141,700	18,850	9,000
Aircraft					
Jet	0	260	300	270	190
Piston	0	20	3,560	680	170
Turboprop	0	10	20	10	10
Subtotal	0	290	3,880	960	370
Vessels	0	0	0	0	0
Railroads	420	1,160	630	1,430	2,340
STUDY AREA	1,260	3,030	146,210	21,240	11,710

into grids by evenly distributing the fuel into all grids which had railroad activity.

Emissions caused by railroads in the Study Area had a substantial effect on the amount of sulfur oxides and particulates contributed by the transportation source category. Railroads emitted 420 tons per year (33 percent) of the sulfur oxides and 1,160 tons per year (38 percent) of the particulates. The emissions of sulfur oxides and particulates were less significant when compared to all sources in the Study Area.

SOLID WASTE

The solid waste source category is concerned with the air pollutant emissions caused by refuse disposal. Refuse includes not only the municipal refuse, but also refuse generated by commercial and industrial facilities. The primary means of disposing of refuse are: landfills, dumps, incinerators, and on-site burning. Only open burning dumps, incinerators and on-site burning are considered air pollutant sources.

The total tons of refuse generated in the Albuquerque area was determined by using a generation rate of 4.5 pounds per person per day. This total includes municipal, commercial and industrial refuse. In order to determine the amount of refuse being disposed of by each means of disposal, data was collected on all landfills, dumps and conical burners in the Study Area. The amount of refuse being disposed of by on-site incineration and on-site burning was determined with national averages. These data were assembled into a refuse balance (Table 10).

The proportioning of the county totals into grids was done in three steps. The first was the accurate locating of all open-burning dumps which had been surveyed. The refuse being disposed of by the remaining open-burning dumps was proportioned evenly into the rural grids of each county. The on-site burning and on-site incineration were distributed into grids on the basis of population.

Emissions caused by the open burning of refuse, contributed most of the emissions in the solid waste source category (Table 11). Open

TABLE 10 SOLID WASTE DISPOSAL BALANCE FOR THE ALBUQUERQUE STUDY AREA, 1969 (Tons/Year)

County	Total Generation	Land Fills and			On-Site Burning
		Incineration Municipal	Non-Burning Dumps	Open Burning Dumps	
Bernalillo County	267,000	--	168,000	--	54,000
Sandoval County	15,000			2,000	13,000
Socorro County	9,000			4,000	5,000
Valencia County	10,000			6,000	4,000
STUDY AREA	301,000	45,000	168,000	12,000	76,000

TABLE 11 AIR POLLUTANT EMISSIONS FROM SOLID WASTE DISPOSAL
 IN THE ALBUQUERQUE STUDY AREA, 1969
 (Tons/Year)

Source Category	Sulfur Oxides	Partic- ulates	Carbon Monoxides	Hydro- carbons	Nitrogen Oxides
Incineration					
Municipal	0	0	0	0	0
On-Site	50	220	990	20	70
Subtotal	50	220	990	20	70
Open Burning					
Dumps	40	610	3,230	1,140	420
On-Site	10	100	510	180	70
Subtotal	50	710	3,740	1,320	490
STUDY AREA	100	930	4,730	1,340	560

burning emissions, which were evenly divided between open burning dumps and on-site burning, ranged from 50 percent of the sulfur oxides to 98 percent of the hydrocarbons.

The solid waste category when compared to the other emission sources in the Study Area ranked third in total tons emitted per year for carbon monoxide, particulates and hydrocarbons.

INDUSTRIAL PROCESSES

The industrial process category is concerned with all industrial air pollutant sources other than the burning of fuel or the disposal of refuse. That portion of fuel which is used for process heating is included in the fuel combustion source category.

Information concerning industrial processes was gathered on an individual plant basis. Each company was contacted and asked to supply the appropriate data. Because of the tremendous cooperation in the Study Area, no engineering estimates had to be made on any industrial facilities. The emission rates from industrial processes were estimated by using standard emission factors published by the Department of Health, Education, and Welfare.²

EVAPORATIVE LOSSES

The evaporative losses source category is concerned with emissions of hydrocarbons. The three primary sources studied in this category were dry cleaning and the automobile. There are a multitude of other domestic and commercial sources of evaporative losses, but these were not included because emission factors were not available.

Dry cleaning emissions were estimated using factors based upon population.² The emissions were also proportioned into counties and grids using population. Evaporative losses by the automobile were estimated using vehicle mile activity. These emissions were distributed in the same manner that the balance of the automobile emissions were.

TABLE 12 AIR POLLUTANT EMISSIONS FROM INDUSTRIAL PROCESSES
IN THE ALBUQUERQUE STUDY AREA, 1969 (Tons/Year)

Industry	Sulfur Oxides	Partic- ulates	Carbon Monoxide	Hydro- carbons	Nitrogen Oxides
Concrete	--	870	--	--	--
Asphalt Batching	--	570	--	--	--
Feed Mills	--	90	--	--	--
Sand and Gravel	--	300	--	--	--
Gypsum	--	1,980	--	--	--
Cement	--	675	--	--	--
Wood Waste	--	540	7,010	590	50
STUDY AREA	0	5,025	7,010	590	50

TABLE 13 HYDROCARBONS EMISSIONS FROM EVAPORATIVE LOSSES IN THE
ALBUQUERQUE STUDY ATEA, 1969 (Tons/Year)

Dry Cleaning	650
Automobile	7,100
TOTAL	7,750

The automobile was the large source in the evaporative losses category with 7,100 tons of hydrocarbons (Table 13). Dry cleaning contributed 650 tons. In the Study Area evaporative losses accounted for 33 percent of all hydrocarbons emitted.

EMISSIONS BY JURISDICTION

The previous section presented air pollutant emissions by source category. In order to show the contribution of each county to the air pollution in the Study Area, their emissions are summarized in Tables 14 through 17.

TABLE 14 SUMMARY OF AIR POLLUTANT EMISSIONS IN BERNALILLO COUNTY
1969 (Tons/Year)

Source Category	Sulfur Oxides	Partic- ulates	Carbon Monoxide	Hydro- carbons	Nitrogen Oxides
Transportation					
Motor Vehicles	660	1,240	111,770	9,270	7,100
Others	370	1,300	4,440	2,220	2,430
Subtotal	1,030	2,540	116,210	11,490	9,530
Stationary Fuel Combustion					
Industry	0	0	0	0	0
Steam-Electric	170	140	0	0	3,550
Residential	40	90	10	0	530
Commercial- Institutional	0	80	0	0	460
Subtotal	210	310	10	0	4,540
Solid Waste Disposal					
Incineration	50	220	990	20	70
Open Burning	30	430	2,290	810	300
Subtotal	80	650	3,280	830	370
Industrial Processes	0	3,130	2,000	170	10
Evaporative Losses	--	--	--	6,250	--
TOTAL ALL SOURCES	1,320	6,630	121,500	18,740	14,450

TABLE 15 SUMMARY OF AIR POLLUTANT EMISSIONS IN SANDOVAL COUNTY
1969 (Tons/Year)

Source Category	Sulfur Oxides	Partic- ulates	Carbon Monoxide	Hydro- carbons	Nitrogen Oxides
Transportation					
Motor Vehicles	60	110	9,440	780	600
Others	20	60	30	70	110
Subtotal	80	170	9,470	850	710
Stationary Fuel Combustion					
Industry	0	0	0	0	0
Steam-Electric	0	0	0	0	0
Residential	10	0	10	0	10
Commercial- Institutional	0	0	0	0	10
Subtotal	10	0	10	0	20
Solid Waste Disposal					
Incineration	0	0	0	0	0
Open Burning	10	120	640	220	80
Subtotal	10	120	640	220	80
Industrial Processes	0	1,880	5,010	420	40
Evaporative Losses	--	--	--	470	--
TOTAL ALL SOURCES	100	2,170	15,130	1,960	850

TABLE 16 SUMMARY OF AIR POLLUTANT EMISSIONS IN SOCORRO COUNTY
1969 (Tons/Year)

Source Category	Sulfur Oxides	Partic- ulates	Carbon Monoxide	Hydro- carbons	Nitrogen Oxides
Transportation					
Motor Vehicles	70	130	11,490	950	730
Other	10	40	20	50	80
Subtotal	80	170	11,510	1,000	810
Stationary Fuel Combustion					
Industry	0	0	0	0	0
Steam-Electric	0	0	0	0	0
Residential	0	0	0	0	10
Commercial- Institutional	0	0	0	0	10
Subtotal	0	0	0	0	20
Solid Waste Disposal					
Incineration	0	0	0	0	0
Open Burning	0	70	380	140	50
Subtotal	0	70	380	140	50
Industrial Processes	0	10	0	0	0
Evaporative Losses	--	--	--	580	--
TOTAL ALL SOURCES	80	250	11,890	1,720	880

TABLE 17 SUMMARY OF AIR POLLUTANT EMISSIONS IN VALENCIA COUNTY
1969 (Tons/Year)

Source Category	Sulfur Oxides	Partic- ulates	Carbon Monoxide	Hydro- carbons	Nitrogen Oxides
Transportation					
Motor Vehicles	50	100	9,010	750	570
Other	20	50	30	60	90
Subtotal	70	150	9,040	810	660
Stationary Fuel Combustion					
Industry	0	0	0	0	0
Steam-Electric	0	0	0	0	0
Residential	10	0	0	0	10
Commercial- Institutional	0	0	0	0	20
Subtotal	10	0	0	0	30
Solid Waste Disposal					
Incineration	0	0	0	0	0
Open Burning	0	80	420	150	50
Subtotal	0	80	420	150	50
Industrial Processes	0	10	0	0	0
Evaporative Losses	--	--	--	450	--
TOTAL ALL SOURCES	80	240	9,460	1,410	740

EMISSIONS BY GRID

For the purpose of defining the geographical variation in air pollutant emissions in the Study Area, the emissions were apportioned onto a grid coordinate system. The emissions were divided into two source groups--point sources and area sources. Nineteen point sources are presented individually in Table 18. Each of these point sources emitted more than 0.25 tons per day of a pollutant. The approximate location of these point sources are shown in Figure 5. Area sources which made up the balance of emissions have not been presented separately, but have been combined with the point source emissions and presented with emissions from all sources in Table 19.

In order to present a visual representation of the emissions of pollutants by grid, emission density maps have been prepared. Emission densities were obtained by summing the annual area and point source emissions for each grid and dividing this total by the land area of the grid. Figures 6 through 10 show the variation in emission densities for the respective grids throughout the Study Area.

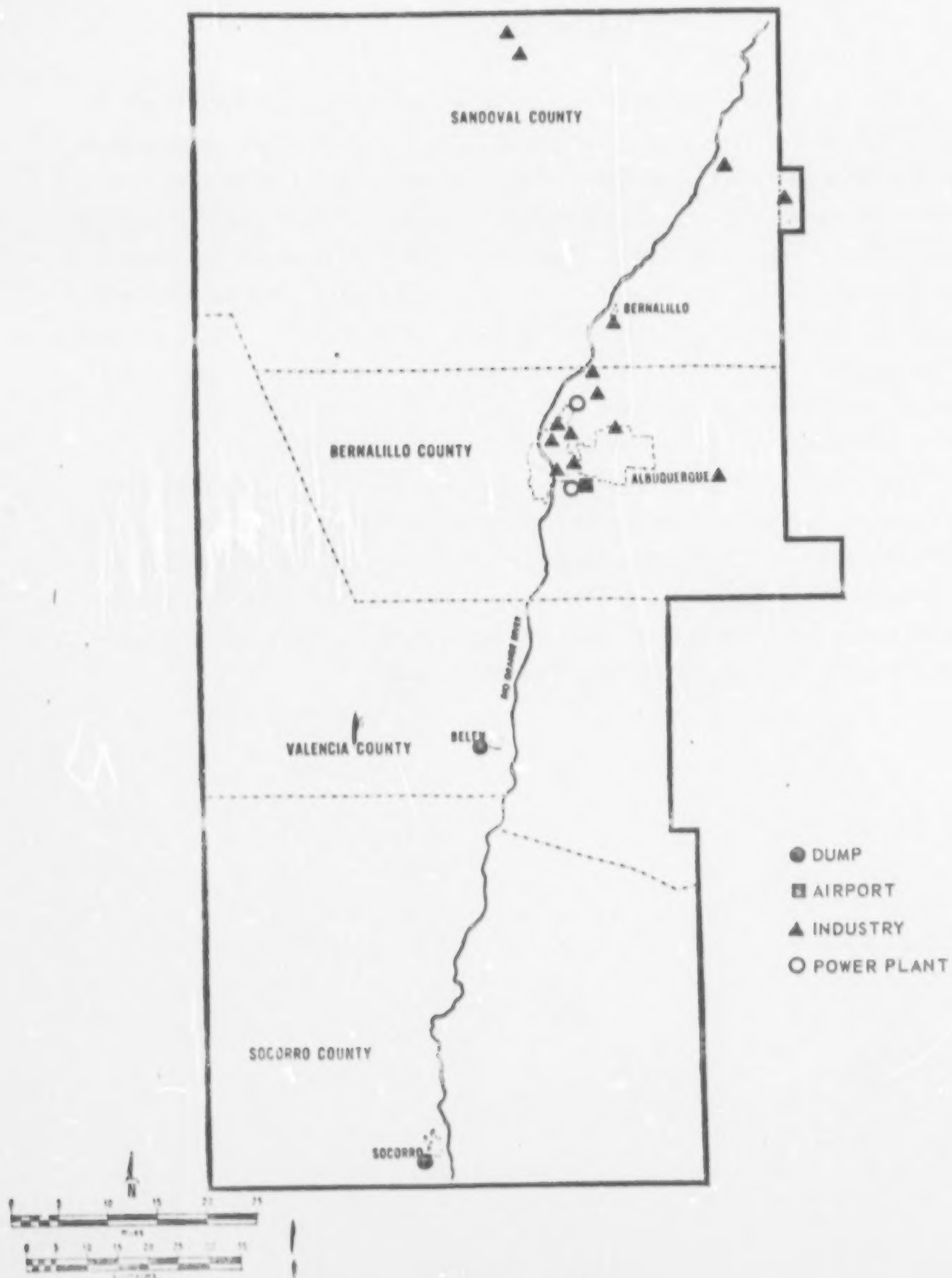


Figure 5. Point source location map for Albuquerque study area.

TABLE 18- SUMMARY OF AIR POLLUTANT EMISSIONS FROM POINT SOURCES IN ALBUQUERQUE STUDY AREA, 1969 (Tons/Day)

Source Category	Grid	HC	VC	SOx		PART.		CO		HC		NOx	
				S	A	S	A	S	A	S	A	W	A
Industry	1	3420	39510	0.0	0.0	0.13	0.13	1.77	1.77	0.14	0.14	0.00	0.00
Industry	1	3450	39550	0.0	0.0	0.68	0.68	8.90	8.90	0.74	0.74	0.06	0.06
Industry	2	3780	39305	0.0	0.0	0.06	0.06	0.88	0.88	0.06	0.06	0.00	0.00
Industry	7	3890	39240	0.0	0.0	4.09	4.09	0.00	0.00	0.00	0.00	0.00	0.00
Industry	11	3590	39070	0.0	0.0	0.15	0.15	2.13	2.13	0.17	0.17	0.01	0.01
Industry	14	3552	38929	0.0	0.0	1.31	1.31	0.00	0.00	0.00	0.00	0.00	0.00
Industry	14	3548	38970	0.0	0.0	0.81	0.81	0.00	0.00	0.00	0.00	0.00	0.00
Power Plant	14	3545	38928	0.2	0.2	0.28	0.26	0.00	0.00	0.00	0.00	6.84	7.03
Industry	17	3486	38854	0.0	0.0	0.39	0.39	5.19	5.19	0.43	0.43	0.03	0.03
Industry	17	3495	38875	0.0	0.0	0.32	0.32	0.00	0.00	0.00	0.00	0.00	0.00
Industry	18	3516	38859	0.0	0.0	1.41	1.41	0.00	0.00	0.00	0.00	0.00	0.00
Industry	19	3586	38888	0.0	0.0	0.70	0.70	0.00	0.00	0.00	0.00	0.00	0.00
Industry	22	3730	38800	0.0	0.0	1.85	1.85	0.00	0.00	0.00	0.00	0.00	0.00
Industry	24	3492	38813	0.0	0.0	0.63	0.63	0.00	0.00	0.00	0.00	0.00	0.00
Industry	25	3501	38828	0.0	0.0	0.71	0.71	0.00	0.00	0.00	0.00	0.00	0.00
Power Plant	31	3502	38770	0.2	0.2	0.12	0.10	0.00	0.00	0.00	0.00	2.72	2.68
Airport	31	3535	38790	0.0	0.0	0.76	0.76	10.63	10.63	2.63	2.63	1.02	1.02
Drain	41	3350	38370	0.0	0.0	0.10	0.10	0.58	0.58	0.20	0.20	0.07	0.07
Drain	51	3240	37680	0.0	0.0	0.08	0.08	0.46	0.46	0.16	0.16	0.06	0.06

Table 19 SUMMARY OF AIR POLLUTANT EMISSIONS
TONS/YEAR

GRID AREA	SOX			PART			CO			HC			NOX		
	S	W	A	S	W	A	S	W	A	S	W	A	S	W	A
1 347.4	0.0	0.0	0.0	0.9	0.9	0.9	11.6	11.4	11.5	1.1	1.0	1.0	0.1	0.2	0.1
2 347.4	0.0	0.0	0.0	4.2	4.2	4.2	1.8	1.6	1.7	0.2	0.2	0.2	0.1	0.1	0.1
3 617.7	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.3	0.3	0.1	0.0	0.1	0.0	0.0	0.0
4 154.4	0.0	0.0	0.0	0.0	0.0	0.0	0.6	0.5	0.5	0.1	0.1	0.1	0.0	0.0	0.0
5 38.6	0.0	0.0	0.0	0.1	0.1	0.1	1.0	0.8	0.9	0.3	0.2	0.2	0.3	0.3	0.2
6 38.6	0.0	0.0	0.0	0.1	0.1	0.1	5.5	4.3	4.8	0.8	0.6	0.7	0.4	0.3	0.4
7 38.6	0.0	0.0	0.0	0.1	0.1	0.1	5.5	4.3	4.8	0.8	0.6	0.7	0.4	0.3	0.4
8 38.6	0.0	0.0	0.0	0.1	0.1	0.1	7.0	5.6	6.1	1.0	0.8	0.9	0.5	0.4	0.4
9 38.6	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.3	0.3	0.1	0.0	0.0	0.0	0.0	0.0
10 38.6	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.3	0.3	0.1	0.0	0.0	0.0	0.0	0.0
11 38.6	0.0	0.0	0.0	0.2	0.2	0.2	7.3	6.2	6.6	0.9	0.7	0.8	0.3	0.3	0.3
12 154.4	0.0	0.0	0.0	0.1	0.1	0.1	0.8	0.7	0.8	0.2	0.2	0.2	0.1	0.1	0.1
13 38.6	0.0	0.0	0.0	0.1	0.1	0.1	4.0	3.2	3.5	0.6	0.4	0.5	0.3	0.3	0.3
14 38.6	0.5	0.5	0.5	3.2	3.2	3.2	24.3	19.4	21.2	3.7	3.1	3.3	9.6	8.9	9.1
15 347.4	0.1	0.1	0.1	0.2	0.1	0.1	13.8	10.8	11.9	1.8	1.4	1.6	0.9	0.7	0.8
16 9.6	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.8	0.9	0.2	0.1	0.1	0.1	0.1	0.1
17 9.6	0.1	0.1	0.1	1.1	1.1	1.1	21.4	18.1	19.3	2.9	2.4	2.6	1.1	1.5	1.2
18 9.6	0.4	0.3	0.3	2.3	2.3	2.3	42.6	33.7	36.9	6.3	5.1	5.5	3.3	3.2	3.2
19 9.6	0.2	0.2	0.2	1.3	1.3	1.3	36.3	28.7	31.4	5.1	4.1	4.5	2.4	2.5	2.3
20 9.6	0.0	0.1	0.0	0.2	0.2	0.2	7.3	5.8	6.4	1.1	0.9	1.0	0.5	0.6	0.5
21 9.6	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0
22 154.4	0.1	0.1	0.1	0.1	0.1	0.1	11.1	8.7	9.6	1.5	1.2	1.3	0.7	0.6	0.6
23 9.6	0.0	0.0	0.0	0.1	0.1	0.1	7.5	5.9	6.5	1.1	0.9	0.9	0.5	0.6	0.5
24 9.6	0.7	0.7	0.7	2.7	2.8	2.7	41.7	33.2	36.3	7.3	6.2	6.6	5.0	5.3	5.0
25 9.6	0.5	0.5	0.5	2.0	2.0	1.9	64.5	51.0	55.8	9.3	7.5	8.2	4.7	4.7	4.5

26	9.6	0.4	0.3	0.3	0.9	0.9	0.9	57.2	45.2	49.5	8.1	6.5	7.1	3.7	3.9	3.6
27	9.6	0.1	0.1	0.1	0.2	0.2	0.2	13.5	10.7	11.7	1.9	1.5	1.7	0.9	0.9	0.9
28	9.6	0.0	0.0	0.0	0.1	0.1	0.1	5.5	4.3	4.7	0.7	0.6	0.6	0.3	0.3	0.3
29	9.6	0.0	0.0	0.0	0.0	0.1	0.0	2.6	2.1	2.3	0.4	0.3	0.3	0.2	0.2	0.2
30	9.6	0.1	0.1	0.1	0.4	0.4	0.4	3.3	2.7	2.9	0.9	0.8	0.8	0.8	0.8	0.8
31	9.6	0.2	0.2	0.2	1.0	1.0	1.0	15.0	14.7	15.1	3.4	3.2	3.3	4.4	4.1	4.0
32	9.6	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.2	0.2	0.0	0.0	0.0	0.0	0.0	0.0
33	38.6	0.0	0.0	0.0	0.0	0.0	0.0	0.6	0.5	0.6	0.1	0.1	0.1	0.0	0.1	0.1
34	9.6	0.0	0.0	0.0	0.0	0.0	0.0	1.4	1.1	1.2	0.2	0.2	0.2	0.1	0.1	0.1
35	9.6	0.1	0.1	0.1	0.4	0.3	0.3	6.4	5.0	5.5	1.2	1.0	1.1	1.0	0.9	0.9
36	9.6	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0
37	9.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
38	38.6	0.1	0.1	0.1	0.3	0.3	0.3	2.7	2.2	2.4	0.7	0.6	0.6	0.7	0.7	0.7
39	347.4	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.1	0.2	0.0	0.0	0.0	0.0	0.0	0.0
40	154.4	0.1	0.1	0.1	0.2	0.2	0.2	8.8	7.0	7.6	1.2	1.0	1.1	0.6	0.6	0.6
41	38.6	0.2	0.2	0.2	0.5	0.5	0.5	20.7	16.4	18.0	3.1	2.5	2.7	1.6	1.5	1.5
42	38.6	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.1	0.2	0.0	0.0	0.0	0.0	0.0	0.0
43	347.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
44	38.6	0.0	0.0	0.0	0.0	0.0	0.0	1.9	1.5	1.6	0.2	0.2	0.2	0.1	0.1	0.1
45	38.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
46	154.4	0.0	0.0	0.0	0.0	0.0	0.0	3.2	2.5	2.8	0.4	0.4	0.4	0.2	0.2	0.2
47	347.4	0.0	0.0	0.0	0.1	0.0	0.0	3.4	2.7	3.0	0.5	0.4	0.4	0.2	0.2	0.2
48	154.4	0.0	0.0	0.0	0.1	0.1	0.1	3.9	3.1	3.4	0.5	0.4	0.5	0.3	0.2	0.2
49	38.6	0.1	0.1	0.1	0.3	0.2	0.2	14.2	11.2	12.3	2.0	1.6	1.8	1.0	0.9	0.9
50	38.6	0.0	0.0	0.0	0.0	0.0	0.0	2.3	1.8	2.0	0.3	0.2	0.3	0.1	0.1	0.1
51	38.6	0.1	0.1	0.1	0.3	0.3	0.3	8.7	7.0	7.6	1.3	1.1	1.2	0.7	0.6	0.6
52	38.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.0	0.0	0.0

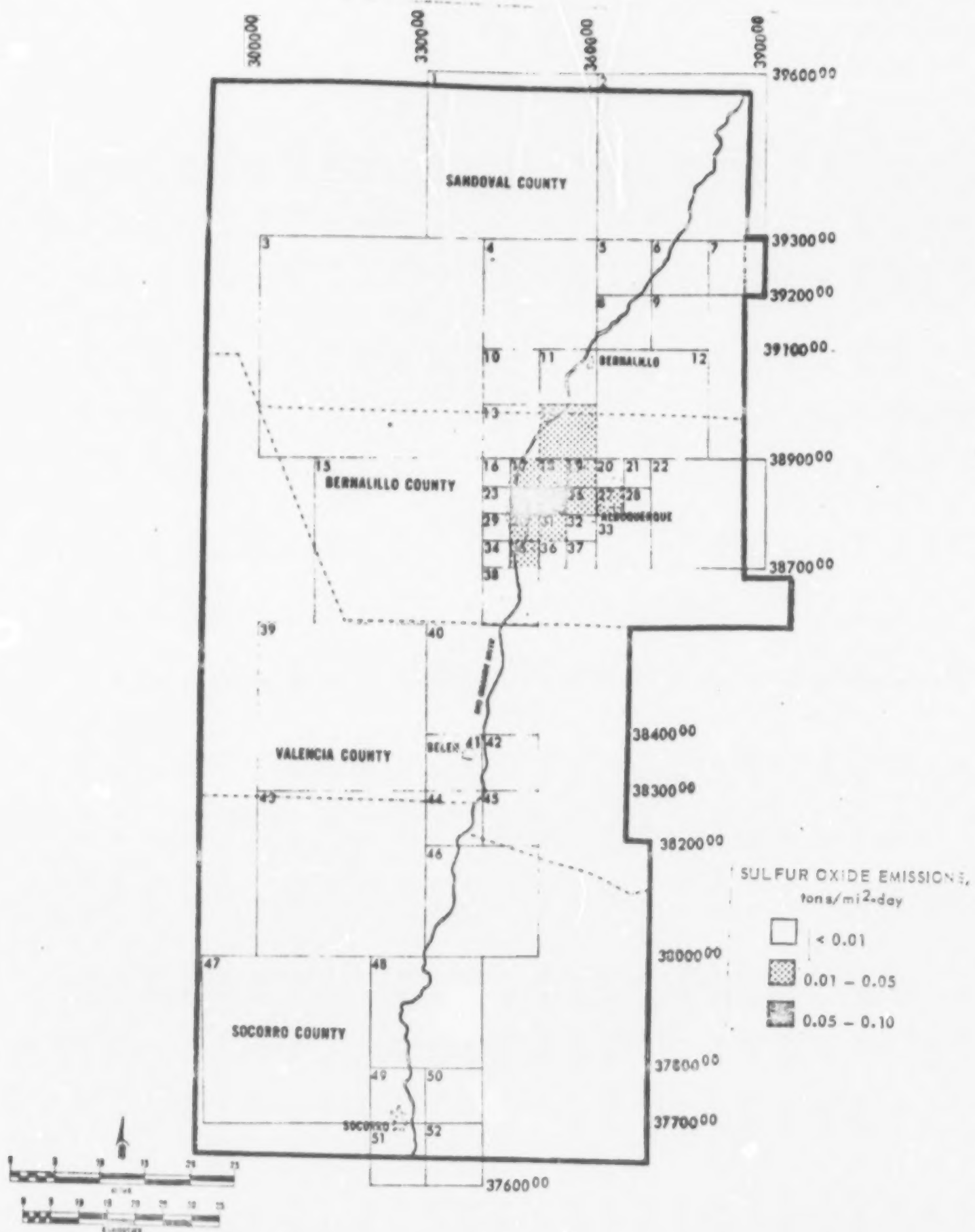


Figure 6. Sulfur oxide emission density map for the Albuquerque study area.

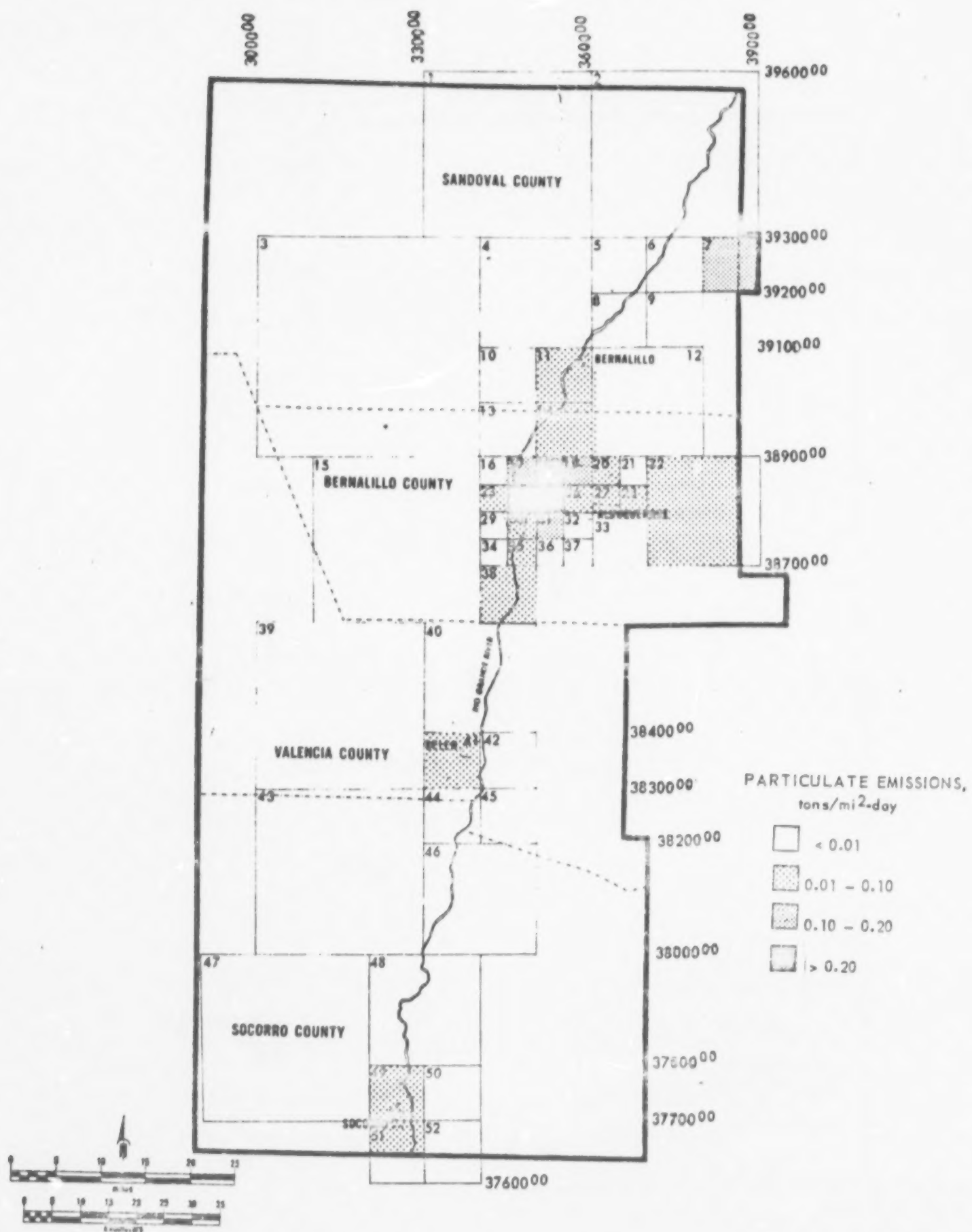


Figure 7. Particulate emission density map for the Albuquerque study area.

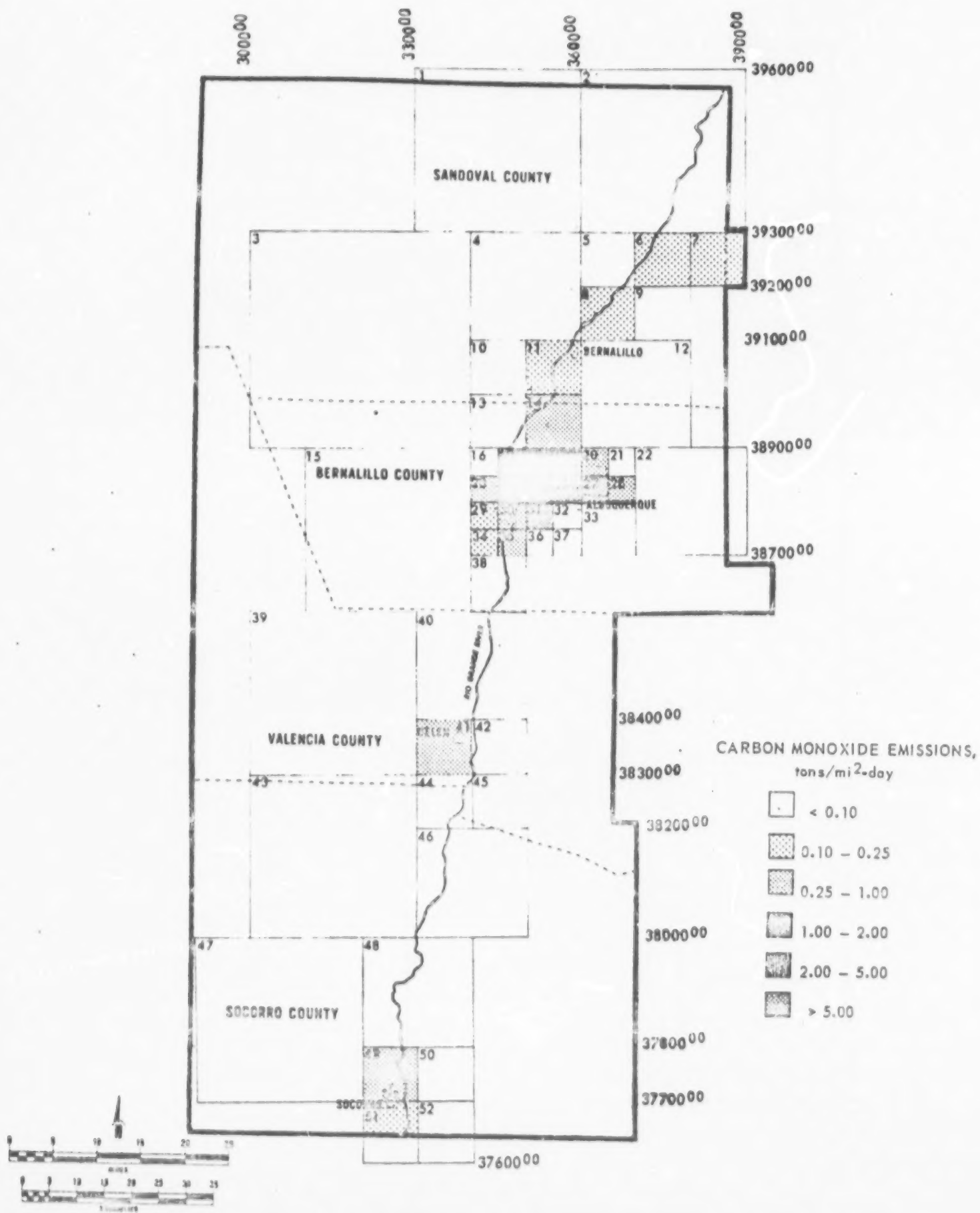


Figure 8. Carbon monoxide emission density map for the Albuquerque study area.

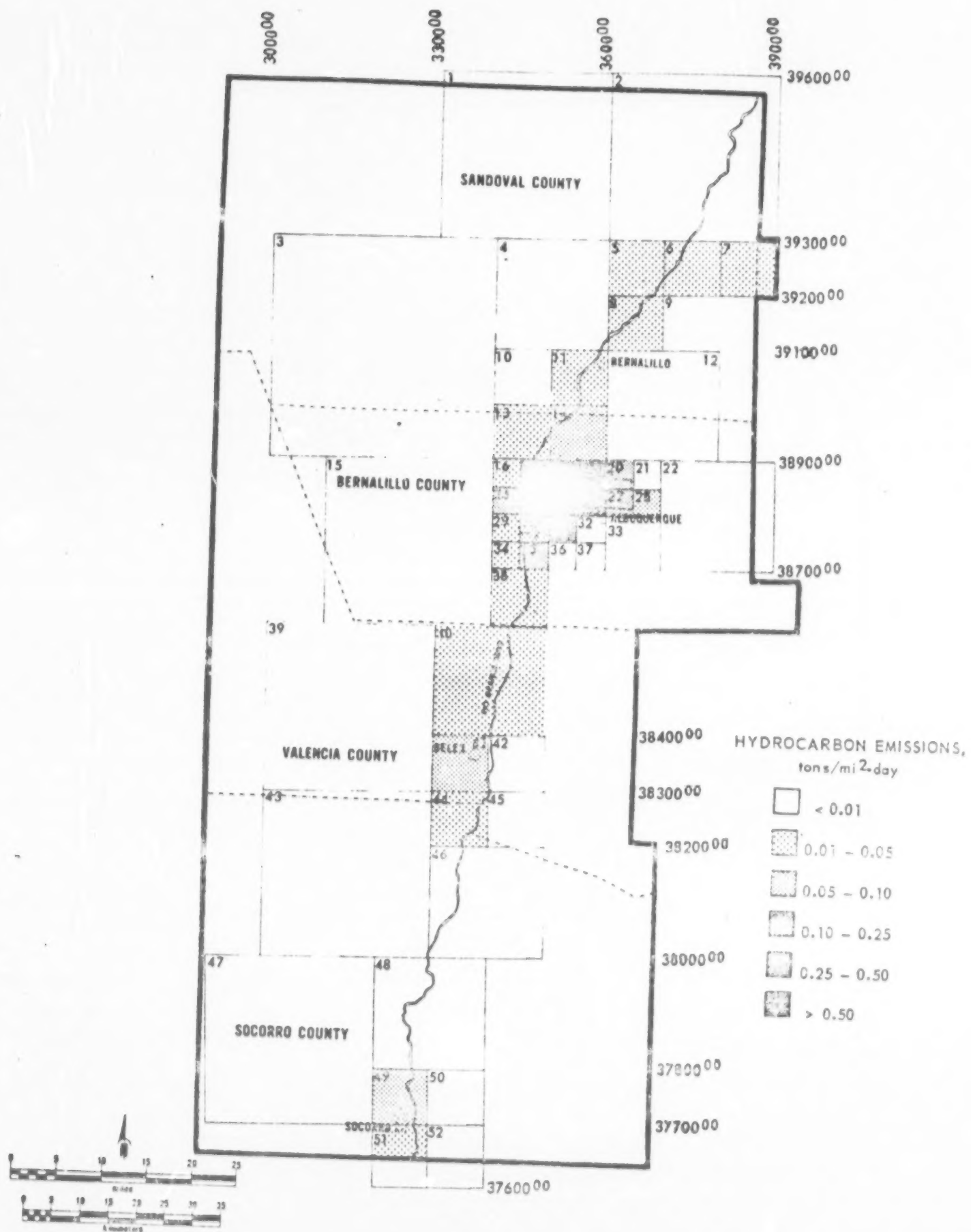


Figure 9. Hydrocarbon emission density map for the Albuquerque study area.

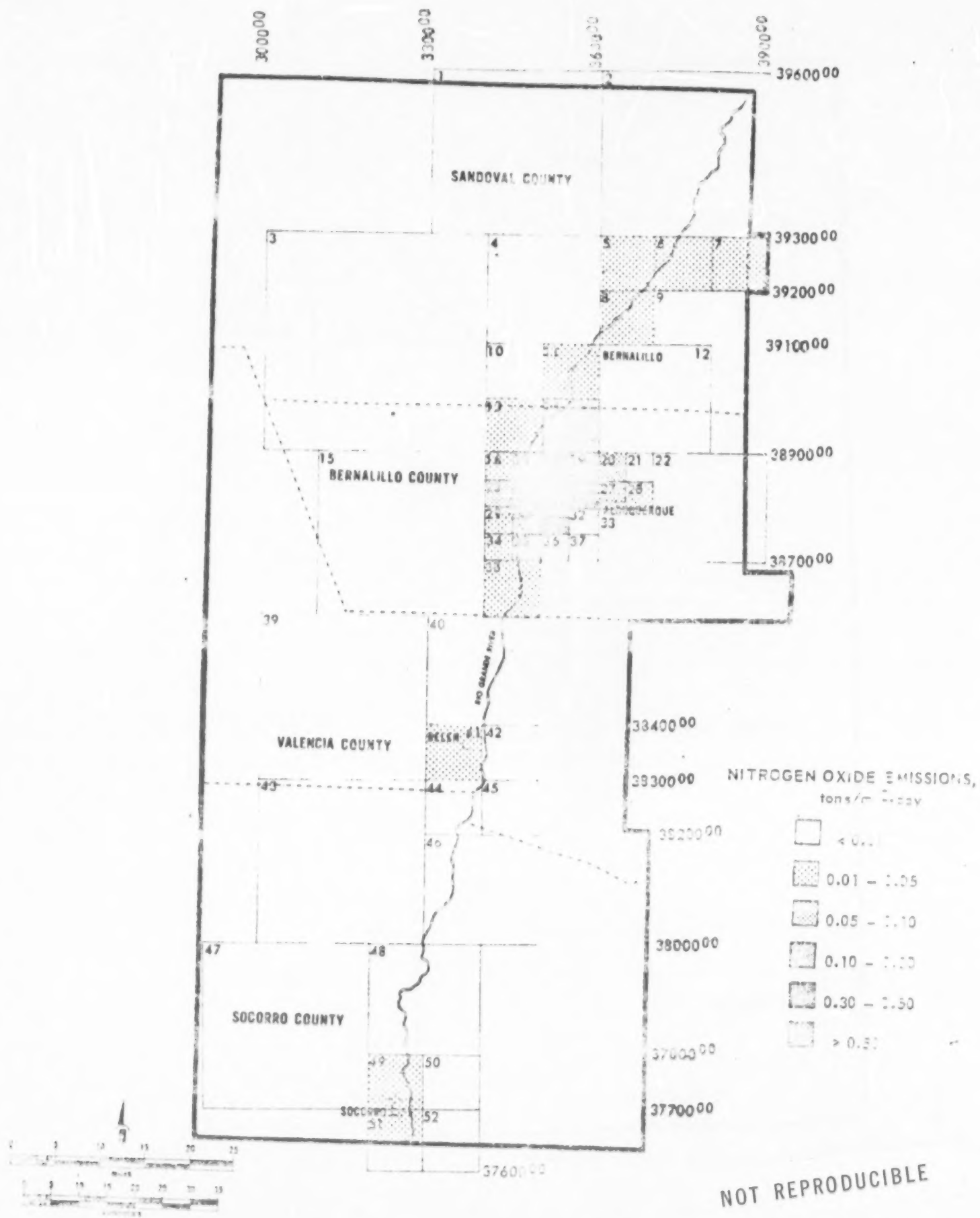


Figure 10. Nitrogen oxide emission density map for Albuquerque study area.

REFERENCES

1. Ozolins, G. and R. Smith, Rapid Survey Technique for Estimating Community Air Pollution, DHEW, PHS, October 1966.
2. Duprey, R. L., Compilation of Air Pollution Emission Factors, DHEW, PHS, April 1967.
3. United States Census of Housing: 1960 - New Mexico, United States Department of Commerce, Bureau of the Census.
4. United States Census of Population: 1960 - New Mexico, United States Department of Commerce, Bureau of the Census.
5. Vehicle Miles on New Mexico Highways, New Mexico State Department of Highways, 1969.
6. 1963 Census of Business: Retail Trade, United States Department of Commerce, Bureau of the Census.
7. Highway Statistics/1968, United States Department of Transportation.
8. Petroleum Facts and Figures, American Petroleum Institute.
9. 1968 National Survey of Community Solid Waste Practice, Interim Report, DHEW, PHS.
10. Mineral Industry Surveys, Buener Fuel Oils, 1967, United States Department of Interior, Bureau of Mines.
11. National Air Pollution Control Administration Reference Book of Nationwide Emissions, 1968

END

NOT REPRODUCIBLE